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Rice-Field Conversion and Its Impact on Food Availability

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Abstract

One of causes such reduced rice-field area is rice-field conversion, which is not proportional to establishment of new rice-field. The research was a survey method, which was intended to: (1) identify the causal factors of the rice-field conversion, (2) calculate the rice-field conversion development, and (3) predict the loss of potential rice production as a result of rice-field conversion. Population of the research was farmers who apply such rice-field conversion at Pangkep Regency, South Sulawesi. Samples were determined using incidental sampling method, performed land quality analysis, land conversion, and prediction the loss of potential unhulled-rice production using time series data. Results of the research showed that, the causal factors of rice-field conversion to non rice-field (turned into embankment) include lower productivity of rice-field, low quality of land, and higher economic values of the land that belonged to the competitors. Rice-field conversion at La'bakkang Subdistrict in Pangkep Regency that had occurred for 5 years (2009 – 2014) covered the area of 124.5 hectares or for about 24.9 hectares per year. Meanwhile, the loss of potential rice production, since that period as a result of rice-field conversion was 1,571,129 kg or 314,225.8 kg per year. Such condition has occurred cumulatively, permanently, and progressively, which meant that loss of food production (particularly rice), which was caused by land conversion, was very huge and cannot be recovered anymore.

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Keywords: land conversion, rice-field, productivity, food availability.

1. Introduction

Up to the present time, rice plays very strategic role in food consumption of the households. The participation level of rice consumption, both in cities and villages, has shown very high percentage, 97 – 100%. It means that only 3 percents of the households do not consume rice (Suroso, 2001). Meanwhile, during 2007-2010, rice production

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tended to increase year-by-year, even relatively small. The Average of unhulled rice production increases for about 1.19 percent year $^{-1}$and the productivity increases for about 1.58 percent/year, but the average of harvesting area reduces for about 0.38 percent year^{-1}, BPS (Anonim, 2011). One of such decreasing rice-field area is caused by rice-field conversion, which is not proportional to the establishment of new rice-field.

Rice-field conversion has created cumulative impacts, which meant that the impact of rice-field conversion on food matters was not perceived during the related years, but also perceived in the future.

The change of rice-field use was caused by low productivity of rice-field, decreasing quality of land, particularly chemical and physical fertility, so that farming operations have become improper economically. Physical damage in soil of the rice-field could be occurred due to bad practices in soil management. These symptoms can be seen in several areas of rice production center, where leveling off productivity has occurred (Sumaryanto et al., 2006).

The change of land use, particularly rice-field that has high productivity, has negative impact on food availability and environmental quality. The impact of land conversion could be occurred cumulatively. It means that potential loss of rice production and crops, working opportunities, and its contribution to PDRB will increase year-by-year, and such rice-field conversion will not return to rice-field anymore. Research conducted by Rosada & Nurliani (2006), showed that rice production contributed 54.25% on average toward PDRB of South Sulawesi along with workforce absorption for about 50.10% on average in comparison with other economy sectors.

Rice-field conversion has directly reduced quantity of food availability, disturbed stability of food availability, and lessened accessibility to foodstuff due to lack of farming land for rice cultivation. Therefore, some regulations are required to control land conversion. In order to control such land conversion, the economic value of rice-field should be increased at least to approach the economic value of land use by the competitors, which is used as embankment

2. Research Methodology

Determining location of the research was done purposively on three villages at La'bakkang Subdistrict, Pangkep Regency, South Sulawesi by considering that since 2010, majority of the farmers have conversed their rice-fields into embankments. However, the embankments are no longer productive and even to lay fallow. The research was conducted from March 2015 to September 2015.

Populations of the research were owner-farmers/cultivators of the rice-field and fishery breeder. Samples were determined using incidental sampling method, in which the samples were directed to everyone who were met by the researcher, and of course, they had rice-field conversion, and it has been done due to no data existed about population of the farmers who converse their rice-fields.

Data was collected using survey method through observation and deep-interview with the respondents using questionnaires. The collected data in this research included primary and secondary data. The primary data was derived from results of the deep-interview using questionnaires, while the secondary data was derived from the related institutions, such as: *Pemda* (local government), *Bappeda* (Agency for Regional Development), Department of Agriculture, Irrigation Service, Agency for Land Affairs, and Literature Study.

Data analysis of the research used descriptive analysis and inferential statistical analysis. The descriptive analysis was applied to describe internal and external factors, which caused rice-field conversion, by conducting land quality analysis using *Index Square Road Method*, Sys et al. (1993), land conversion and prediction for the loss of potential unhulled-rice production using the formulation of $Q\,ti = Lti * I\,ti * Yti$ (Irawan & Friyatno, 2002).

3. Result and Discussion

Rice-field conversion, which occurs at the region, where the research was done, occurred due to low quality of rice-field as a result of sea water pollution. Low quality of rice-field has caused low productivity of the yielded unhulled-rice. The dominant factor that caused such rice-field conversion is sea water pollution. If a farmer changes his rice-field into embankment, it will affect quality of rice-field around the embankment. Such condition has become the trigger of the extended change of land use. The farmers assumed that their rice-fields have no longer economically profitable. Besides that, the embankment prospect is considered more profitable. High price of shrimps as export commodity has encouraged owners of the rice-fields to converse their lands.

Tabel 1. Causal Factor of Rice-Field Conversion at La'bakkang Subdistrict, Pangkep Regency

Causal Factor	Response of Fishery Breeder	
	Yes	No
Low productivity of unhulled-rice	10 (33.3%)	20 (66.6%)
Low quality of land	7 (23.3%)	23 (76.6%)
Rice-field polluted with sea water	30 (100.0%)	0 (0.0%)
Competitor's land is more profitable	14 (46.6%)	16 (53.3%)

Productions of the unhulled-rice from rice-field management at three sampled-villages in La'bakkang Subdistrict are presented in table below

Tabel 2. Mean of Unhulled-Rice Production on Rice-Fields at Three Sampled-Villages in La'bakkang Subdistrict, Pangkep Regency, in 2015

Village	Mean of Land Area (Ha)	Mean of Production (kg/farmer)	Mean of Production (kg/hectare)	Productivity of the Village (kg ha^{-1})
Bonto Manai	0.42	1,804	4,304	6,000
Pundata Baji	0.51	2,275	4,499	5,000
Manakku	0.82	3,668	4,473	4,700
Mean	0.58		4,425	5,250
Productivity of Regency				6,000

Table 2 shows that rice productivities at three sampled-villages in La'bakkang Subdistrict, Pangkep Regency Kabupaten Pangkep, are very low in comparison with productivity at the level of La'bakkang subdistrict. Average productivity value of the farmers was 4,425 kg ha^{-1}, and at the village level was 5,525 kg ha^{-1}, while at subdistrict level was 6,000 kg ha^{-1}, Office of the Department of Agriculture for Food Crops, Pangkep Regency (Anonim, 2015). The condition is one of causes why the famers change their rice-fields into embankments by considering that rice-fields are no longer profitable while embankments are more profitable from the economy aspect. Furthermore, the respondent's farmers who are not willing to converse their rice-fields, they prefer to keep their rice-fields with the reason that the unhulled-rice production is to support their household's consumption.

Table 3. Land Index Value and Limiting Factor of Rice-Field

Sample	Land Index	Land Suitability Class	Limiting Factor	Location
1	41.76	S3	Nutrient N& K	Bonto Manai Village
2	40.06	S3	Nutrient N & K	Bonto Manai Village
3	50.00	S3	Nutrient N	Bonto Manai Village
4.	42.35	S3	Nutrient N & K	Bonto Manai Village
5	46.58	S3	Nutrient N & K	Pundata Baji Village
6	34.05	S3	Nutrient N & K	Pundata Baji Village
7	40.06	S3	Nutrient N & K	Pundata Baji Village
8	46.68	S3	Nutrient N & K	Manakku Village
9	40.25	S3	Nutrient N & K	Manakku Village
10	42.65	S3	Nutrient N & K	Manakku Village

Rice breeding on the rice-field requires specific physical and chemical properties characteristics. Soil fertility highly determines rice productivity, besides depends on physical condition of the soil, climate, and topography,

Amacher et al. (2000). Land characteristics, which were observed in this research, related to growth requirements of rice crops, soil fertility. Soil fertility characteristic refers to nutrient retention, which includes: cation exchange capacity, base saturation, pH of the soil, C-organic of the soil. Land index value is obtained by providing weight to land characteristics in accordance with requirements of the rice growth based on criteria Sys et al. (1991). Results of weighing and land index value are presented in Table 3.

Rice-field in location of the research has land suitability class S3 (according to marginal) by land index value ranges 34 – 50. Such land that has S3 suitability class is land that has moderate limiting factor (2 types) of soil fertility characteristic. Land productivity of the land will reduce and profit of the farming operation will get lower due to high input of production, which is required for improvement. According to Djaenuddin et al. (2003) land with suitability level of S3 (according to marginal) has more limiting factors and requires more additional inputs/capitals to improve quality of the land. Therefore, the government's intervention is required to assist the farmers.

Results of the land suitability analysis showed that land characteristics, which have become the limiting factor in increasing rice production at the area where the research was conducted is soil fertility, which include availability of N and K. Both limiting factors are categorized as light grade. Low availability of N in the soil relates to knowledge of the farmers about dose and the right ways in applying fertilizer. Average application of Urea is given in accordance with recommendation of the local Farm Extension Officer. The application of Urea by spreading it over the soil surface (*broadcasting*) is less efficient due to it may be washed away by the rain water, so that less N will be absorbed by the crop. The second limiting factor is low availability of K in the soil, which the farmers do not generally apply KCL or NPK due to they are costly and the yields are insignificant, according to the respondents. Based on the description above, soil fertility characteristics, such as N and K availability, have become the limiting factor of light grade (S3) and considered as the main priority that must be improved by farmers and government

Rice-field conversion has become serious threat for food security due to its impact on food matters that occur permanently, cumulatively, and progressively. It means that potential loss of crops and rice production, working opportunity, and environmental damages will increase year-by-year, while such rice-field that has changed into embankment would not return to be rice-field anymore.

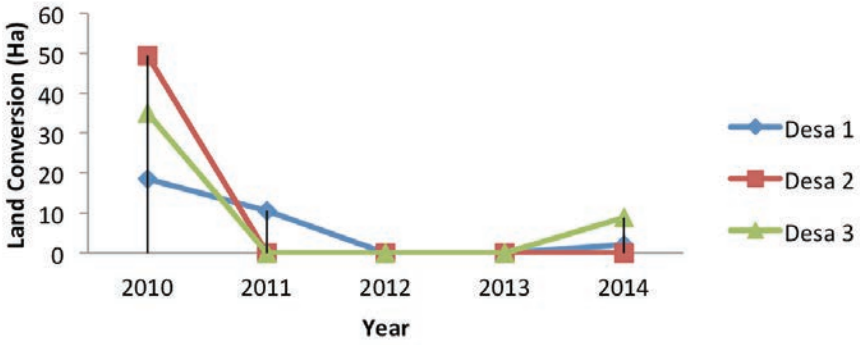

Figure 1. Development of Rice-Field Conversion at Three Sampled-Villages in La'bakkang Subdistrict, Pangkep Regency, during 2010 – 2014.

Figure 1 shows that rice-field conversion at those three-sampled-villages has occurred since 2010. The phenomena showed that rice-field has turned into embankment. Development of land conversion during the period of 2010 – 2014 at those three sampled-villages has decreased. Total area of rice-fields that have been converted into embankments during the period of 2010 – 2014 included Bonto Manai Village is about 31 hectares, Pundata Baji Village is about 49.4 hectare, and in Manakku Village for about 44 hectare, so that total area of rice-fields that have been converted at three villages in La'bakkang Subdistrict, Pangkep Regency during the period of 2010 – 2014 were 124.5 hectare or 24.9 hectare/year.

Rice-field conversion has created cummulative impacts, which meant that the impacts of rice-field conversion toward food matters were not only perceived during the related years, but also in the following years. It was due to such conversion did not only reduce food production, but also reduce capacity of food production whereas land is

the main production factor, so that if land does not exist, the process of food production process would not exist as well.

Table 4. Prediction for Unhulled-Rice Production Loss in Bonto Manai Village, La'bakkang Subdistrict, Pangkep Regency (2010 – 2014).

Year	Area of Conversion (LKt) (Hectare)	Cumulative Conversion Land (LKKt) (Hectare)	Index of Rice Planting/Year (It)	Rice Productivity (Yt) (Kg/Hectare)	Prediction of Production Loss (Qt) (kg)
2010	-18.5	-18.5	1 x	5,442	-100,677
2011	-10.5	-29.0	1 x	3,000	-87,000
2012	0.0	-29.0	1 x	6,000	-174,000
2013	0.0	-29.0	1 x	6,000	-174,000
2014	-2.0	-31.0	1 x	6,000	-186,000
Total Loss of Unhulled-Rice during the Period (2010 - 2014)					-721,677

Table 4 shows that prediction for the unhulled-rice production loss in Bonto Manai Village occurred permanently and cumulatively from 2010 to 2014 was 721,677 kg or averaged 721 tons unhulled-rice**.**

Table 5. Prediction for Unhulled-Rice Production Loss in Pundata Baji Village, La'bakkang Subdistrict, Pangkep Regency (2010 – 2014).

Year	Area of Conversion (LKt) (Hectare)	Cumulative Conversion Land (LKKt) (Hectare)	Index of Rice Planting/Year (It)	Rice Productivity (Yt) (Kg/Hectare)	Prediction of Production Loss (Qt) (kg)
2010	-49.5	-49.5	1 x	5,442	-269,379
2011	0.0	-49.5	1 x	2,886	-142,857
2012	0.0	-49.5	1 x	4,600	-227,700
2013	0.0	-49.5	1 x	4,700	-232,650
2014	0.0	-49.5	1 x	4,700	-232,650
Total Loss of Unhulled-Rice during the Period (2010 - 2014)					-1,105,236

Table 5 shows that prediction for the unhulled-rice production loss in Pundata Baji Village occurred permanently and cumulatively from 2010 to 2014 was 1,105,236 kg or averaged 1,105 tons unhulled-rice.

Tabel 6. Prediction for Unhulled-Rice Production Loss in Manakku Village, La'bakkang Subdistrict, Pangkep Regency (2010 – 2014).

Year	Area of Conversion (LKt) (Hectare)	Cumulative Conversion Land (LKKt) (Hectare)	Index of Rice Planting/Year (It)	Rice Productivity (Yt) (Kg/Hectare)	Prediction of Production Loss (Qt) (kg)
2010	- 35.1	35.1	1 x	5,442	-191,014.2
2011	0.0	35.1	1 x	2,447	-85,889.7
2012	0.0	35.1	1 x	4,159	-145,980.9
2013	0.0	35.1	1 x	4,195	-147,244.5
2014	- 8.9	44.0	1 x	4,195	-184,580.0
Total Loss of Unhulled-Rice during the Period (2010 - 2014)					-754,709.3

Table 6 shows that prediction for the unhulled-rice production loss in Manakku Village occurred permanently and cumulatively from 2010 to 2014 was 754,709.31 kg or averaged 754 tons unhulled-rice. Total loss of the

potential hunhulled-rice production as a result of rice-field conversion that turned into embankments at three sampled-villages in La'bakkang Subdistrict during the period 2010 – 2014 adalah was 1,860,666.6 kg, or averaged 372,133 kg/year.

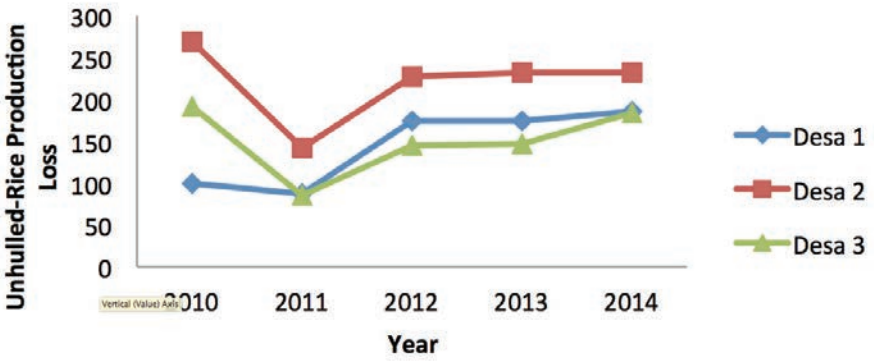

Figure 2. Loss of Potential Unhulled-Rice Production at three Sampled-Villages, La'bakkang Subdistrict, Pangkep Regency, during Period 2010 – 2014.

Figure 2 shows that prediction for the potential unhulled-rice loss at Pundata Baji Village (2) is higher than two other sampled-villages, Bonto Manai (1) and Manakku (3), which occur permanently and cumulatively. Total loss of the potential unhulled-rice production as a result of rice-field conversion into embankment at those three sampled-villages in La'bakkang Subdistrict during the period 2010 – 2014 was 1,860,666.6 kg or averaged 372,133 kg/year.

Rice-field conversion has become serious threat for food security due to its impact on food matters that occur permanently, cumulatively, and progressively. It means that potential loss of crops and rice production, working opportunity, and environmental damages will increase year-by-year. Such rice-field that has changed into embankment would not return to be rice-field anymore. Rice-field conversion has directly reduced quantity of food availability, disturbed stability of food availability, and decreased accessibility to foodstuff as a result of less farming areas for rice-cultivation. Therefore, some regulations are required to control land conversion in order to overcome food scarcity. In order to control such land conversion, the economic value of rice-field should be increased at least to approach the economic value of land use by the competitors, which is used as embankment

4. Conclusion

Results of the research showed that: 1) the causal factors of rice-field conversion include: (a) low productivity of unhulled-rice, (b) low quality of rice-field, (c) rice-field has been polluted with sea water, and (d) higher economic value of the land that is owned by the competitor, 2) averaged low unhulled-rice productivity of the respondent, 4,425 kg ha^{-1} lower than average productivity at the village level, 5,250 kg ha^{-1}. 3) Quality of the rain-fed rice field is categorized moderate, land ability grade S3 (according to marginal) by limiting factor of nutrients availability, N and K. 4) Land conversion that has occurred during the period 2010-2014 was 124.5 hectare or 24.9 hectare/year. 5) Prediction for loss of the potential unhulled-rice production due to the change of land use was quite high, 1,860,666,6 kg or averaged 372,133 kg/year.

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